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## I Claim

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- 1. A process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule, comprising:
- (a) providing an array having a plurality of electrodes and a plurality of capture molecules at sites corresponding to the electrodes;
- (b) non-specifically attaching an oxidation/reduction enzymatic moiety to one or a plurality of target molecules in a sample for analysis to create a prepped target sample;
- (c) administering the prepped target sample to the array and allowing for binding of target molecules to capture molecules;
- (d) adding a substrate to the array that will create a local voltage signal when catalyzed by the oxidation/reduction enzyme through local generation of electrochemical reagents; and
- (e) measuring for the presence or absence of a voltage signal generated locally by electrochemical reagents at each electrode having a capture molecule attached thereto.
- 2. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is generated by a technique selected from the group consisting of *in situ* synthesis with electrochemical techniques, spotting the capture molecules, ink-jet printing the capture molecules, and *in situ* synthesis through photolighography techniques.
- 3. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 2, wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is formed by *in situ* synthesis with electrochemical techniques.
- 4. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the oxidation/reduction enzyme is selected from the group consisting of laccase, horseradish peroxidase,  $\beta$ -galactosidase, glucose oxidase, alkaline phosphatase, dehydrogenases, and combinations thereof.
- 5. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the oxidation/reduction enzyme is attached to the target molecule(s) through an antibody and anti-idiotype antibody combination or through a biotin and streptavidin (or avidin) binding combination.
- 6. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the array having a plurality of electrodes further comprises a porous reaction layer covering the electrodes,

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wherein the porous reaction layer has a thickness of from about 0.1 microns to about 10 microns and whereby the porous reaction layer functions to block diffusion of oxidation/reduction activity products such that there is little lateral signal being picked up at an adjacent electrode.

- 7. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 6, wherein the porous reaction layer is made from a polymeric material selected from the group consisting of polyvinyl alcohol, polyvinyl acetate, polyvinyl alcohol, tricellulose acetate, polyurethane, agarose, controlled porosity glass with a PTFE resin, dextran, epoxy-based polymers, and combinations thereof.
- 8. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the capture molecule is a molecule from the class of molecules selected from the group consisting of oligonucleotides, polypeptides, antibodies, glycosylated polypeptides, polysaccharides, and mixed molecules having monomers from a plurality of the foregoing molecules.
- 9. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein a target molecule is from a class of molecules selected from the group consisting of DNA, RNA, single-stranded DNA, ribosomal RNA, mitochondrial DNA, cellular receptors, glycosylated membrane-bound proteins, non-glycosylated membrane-bound proteins, polypeptides, glycosylated polypeptides, antibodies, cellular antigenic determinants, organic molecules, metal ions, salt anions and cations, and combinations thereof.
- 10. A mircoarray device for detecting binding of a target molecule to a capture probe, comprising:
- (a) an array having a plurality of electrodes and a plurality of capture molecules at sites corresponding to the electrodes;
- (b) an oxidation/reduction enzymatic moiety bound to one or a plurality of target molecules in a sample for analysis, wherein the oxidation/reduction enzymatic moiety bound to the target molecules is incubated with the capture molecules on the array such that binding between capture molecules and target molecules that bind, will occur;
- (c) a substrate molecule that will create a local voltage signal when catalyzed by the oxidation/reduction enzyme through local generation of electrochemical reagents; and
- (e) a voltage signal measuring device electrically connected to each electrode on the array.
- 11. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is generated by a technique selected from the group consisting of

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*in situ* synthesis with electrochemical techniques, spotting the capture molecules, ink-jet printing the capture molecules, and *in situ* synthesis through photolighography techniques.

- 12. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 11 wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is formed by *in situ* synthesis with electrochemical techniques.
- 13. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the oxidation/reduction enzyme is selected from the group consisting of laccase, horseradish peroxidase, β-galactosidase, glucose oxidase, alkaline phosphatase, dehydrogenases, and combinations thereof.
- 14. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the oxidation/reduction enzyme is attached to the target molecule(s) through an antibody and anti-idiotype antibody combination or through a biotin and streptavidin (or avidin) binding combination.
- 15. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the array having a plurality of electrodes further comprises a porous reaction layer covering the electrodes, wherein the porous reaction layer has a thickness of from about 0.1 microns to about 10 microns and whereby the porous reaction layer functions to block diffusion of oxidation/reduction activity products such that there is little lateral signal being picked up at an adjacent electrode.
- 16. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 15 wherein the porous reaction layer is made from a polymeric material selected from the group consisting of polyvinyl alcohol, polyvinyl acetate, polyvinyl alcohol, tricellulose acetate, polyurethane, agarose, controlled porosity glass with a PTFE resin, dextran, epoxy-based polymers, and combinations thereof.
- 17. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the capture molecule is a molecule from the class of molecules selected from the group consisting of oligonucleotides, polypeptides, antibodies, glycosylated polypeptides, polysaccharides, and mixed molecules having monomers from a plurality of the foregoing molecules.
- 18. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein a target molecule is from a class of molecules selected from the group consisting of DNA, RNA, single-stranded DNA, ribosomal RNA, mitochondrial DNA, cellular receptors (*i.e.*, glycosylated or non-glycosylated membrane-bound proteins), polypeptides, glycosylated polypeptides, antibodies, cellular antigenic determinants, organic molecules, metal ions, salt anions and cations, and combinations thereof.